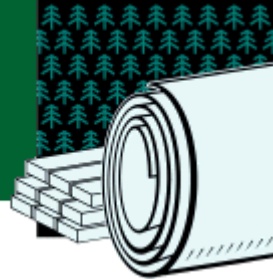


# FOREST PRODUCTS

## Project Fact Sheet



### NON PROCESS ELEMENT (NPE) REMOVAL USING FUNCTIONALIZED MONOLAYERS OF MESOPOROUS SUPPORTS

#### BENEFITS

- Facilitates closure of the bleach cycle
- Removes metal ions and other problematic non-process elements from bleach filtrates
- Reduces effluent discharges from 20–25 m<sup>3</sup>/ton of pulp produced to 5 m<sup>3</sup>/ton
- Lowers emission of organic compounds
- Retains chemical and biological stability
- Generates no secondary waste

#### APPLICATIONS

Mesoporous SAMMS material will be obtained from Mobil Technology Company to ensure development of a commercially viable product. There are no products currently available to remove NPEs from the bleaching cycle. A commercial product is anticipated in 5–10 years and should be adopted by all pulp-bleaching plants.

#### Can This Novel Material Selectively Remove Cations and Anions from Bleach Plant Filtrates?

To become a closed-cycle facility, a mill must not discharge its waste streams into receiving waters. When the water system is closed, however, high levels of dissolved organic and inorganic substances build up in the system, and eventually have a negative effect on the mill's processes.

A nanostructured-porous material was developed by Pacific Northwest National Laboratories (PNNL) and the Mobil Technology Company to selectively remove heavy metals from a waste stream. The material is known as "self-assembled monolayers on mesoporous supports" (SAMMS), and is inserted into the pores of a ceramic material. When toxic water contacts the SAMMS, small amounts of the specialized material have the capacity to absorb large amounts of heavy metals. Researchers will investigate the ability of SAMMS to remove problematic non-process elements (NPEs), such as metal ions, from bleach filtrates in pulp mills.

The use of appropriate SAMMS material in mills could help to close the bleach cycle and thereby reduce discharges of kraft mill effluent from about 20 to 25 m<sup>3</sup>/ton of pulp produced to 5 m<sup>3</sup>/ton. If each of the 30 U.S. operating mills produces 1,000 tons of pulp per day, the new materials could potentially lead to a total annual reduction of 157 million m<sup>3</sup>/year of effluent. If the organic emissions from the plant were reduced 25 percent, the total reduction in organics in the United States and Canada would be 370 million kg/yr. When SAMMS is loaded with toxic metals, the material remains stable and can be removed, without generating secondary waste.

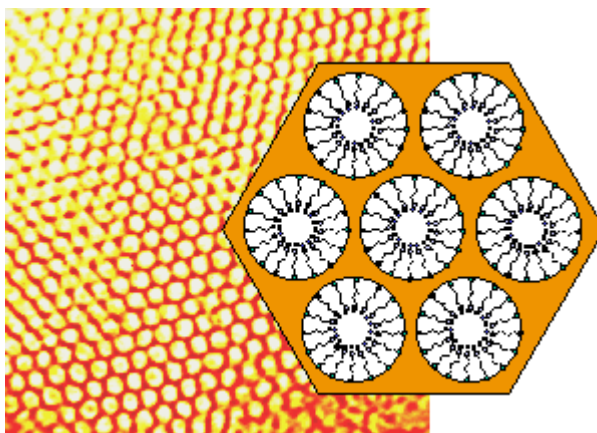


Figure 1 : Schematic illustration of SAMMS.

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## PROJECT DESCRIPTION

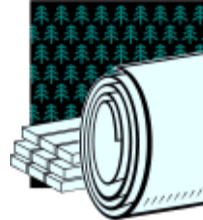
**Goal:** To adapt a new high-efficiency material—self-assembled monolayers on mesoporous supports (SAMMS)—for removing problematic non-process elements (NPEs) from bleach plant filtrates.

Researchers will focus on synthesizing SAMMS that are designed specifically to remove three classes of NPEs: 1) alkaline earth cations (Ca, Ba, Mg); 2) transition metal cations (Mn, Fe, Cu); and 3) certain problematic anions (PO<sub>4</sub>, silicate, aluminate, phenolate).

The ability of different SAMMS to remove NPEs from waste streams will be evaluated in the laboratory. Mobil Technology Company will provide the SAMMS material, and chemical strategies for removing selective NPEs will be tested on simulated bleach-plant materials, and on actual bleach-filtrate slipstreams from industrial kraft mills. SAMMS based on ethylenediaminetetraacetic acid (EDTA) will be synthesized to test for removal of alkaline earth (scale-forming) cations. SAMMS based on ethylenediamine (EDA) will be tested on transition metal ions. Copper-based EDA SAMMS will be tested for removal of oxanions ("problematic anions").

## PROGRESS & MILESTONES

- In Year 1, the binding efficiency of SAMMS will be measured for different classes of NPEs, and SAMMS will be evaluated for their ability to remove scale-forming cations and anions, as well as transition metals from waste streams.
- A go–no go decision will be made at the end of Year 1 depending upon the effectiveness of SAMMS material in selectively removing NPEs in the laboratory.
- In Year 2, the mesoporous ceramic material will be formulated for optimal loading, methods will be developed to regenerate the sorbent materials, various engineering strategies will be tried to minimize pre-filtration steps, and the life-cycle cost of SAMMS for application to bleaching will be analyzed.



### PROJECT PARTNERS

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